

Monitoring to associate a plume of MTBE in Groundwater with a vapor release

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Virginia DEQ

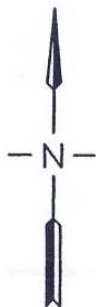
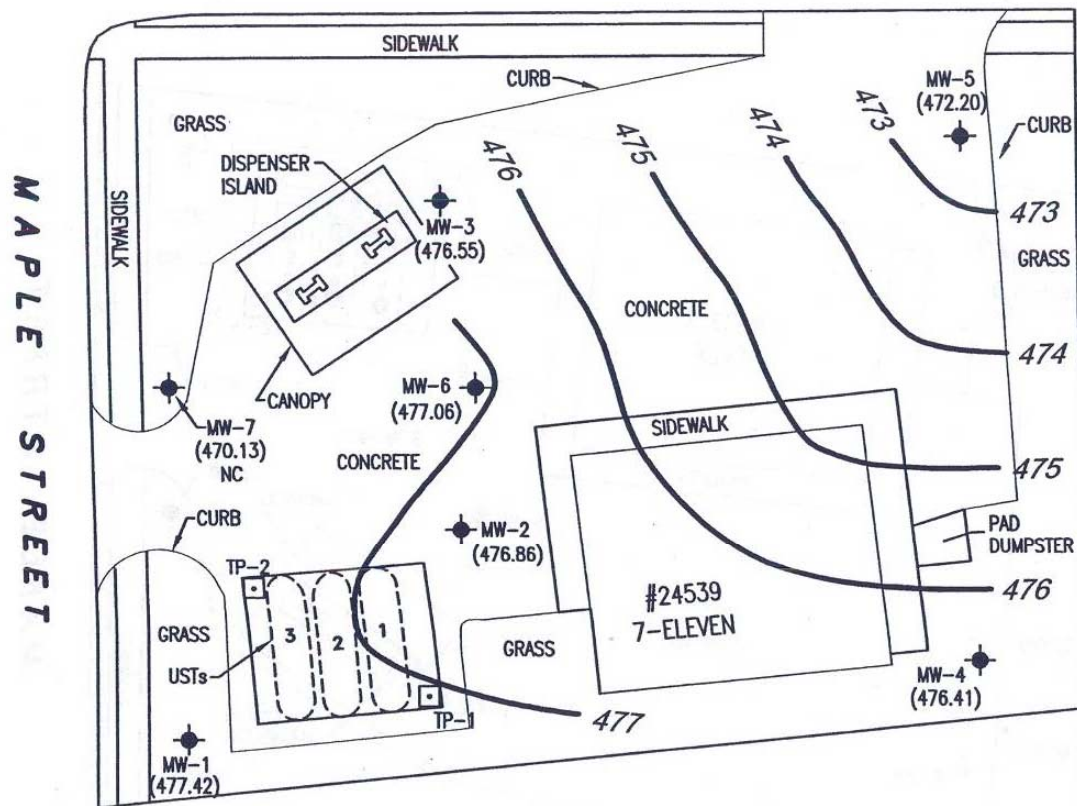
2006 EPA Region III Lust Technical
Conference, Roanoke, Virginia

April 4, 2006

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EAST MAIN STREET (ROUTE 7)



Source 7-Eleven File, IT Corp,
Drawings 822662005,
822662007, and 802078007

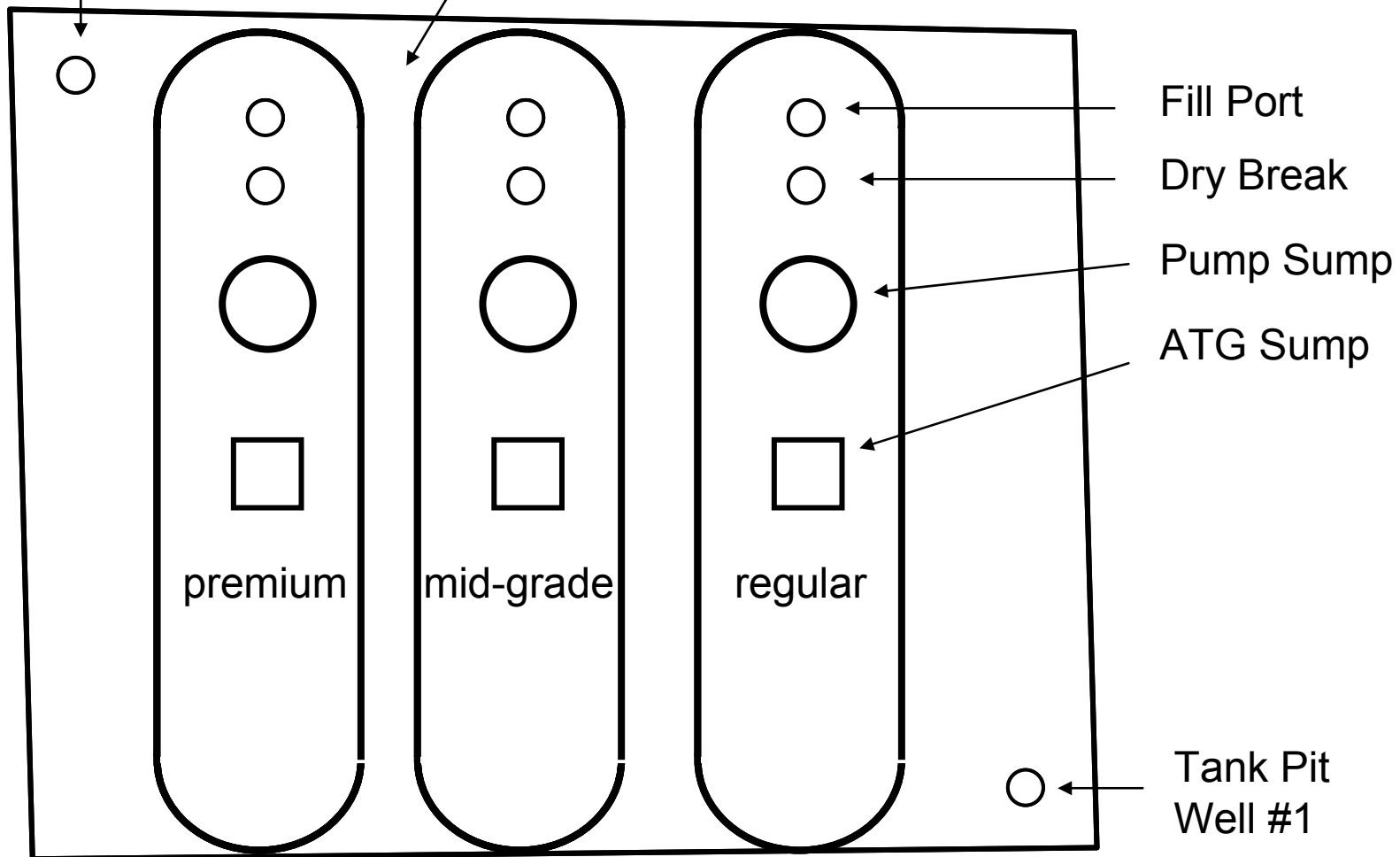
SOURCES:
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IT CORP. DRAWINGS 822662005, 822662007, AND 802078007

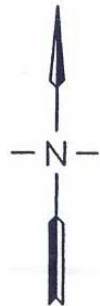
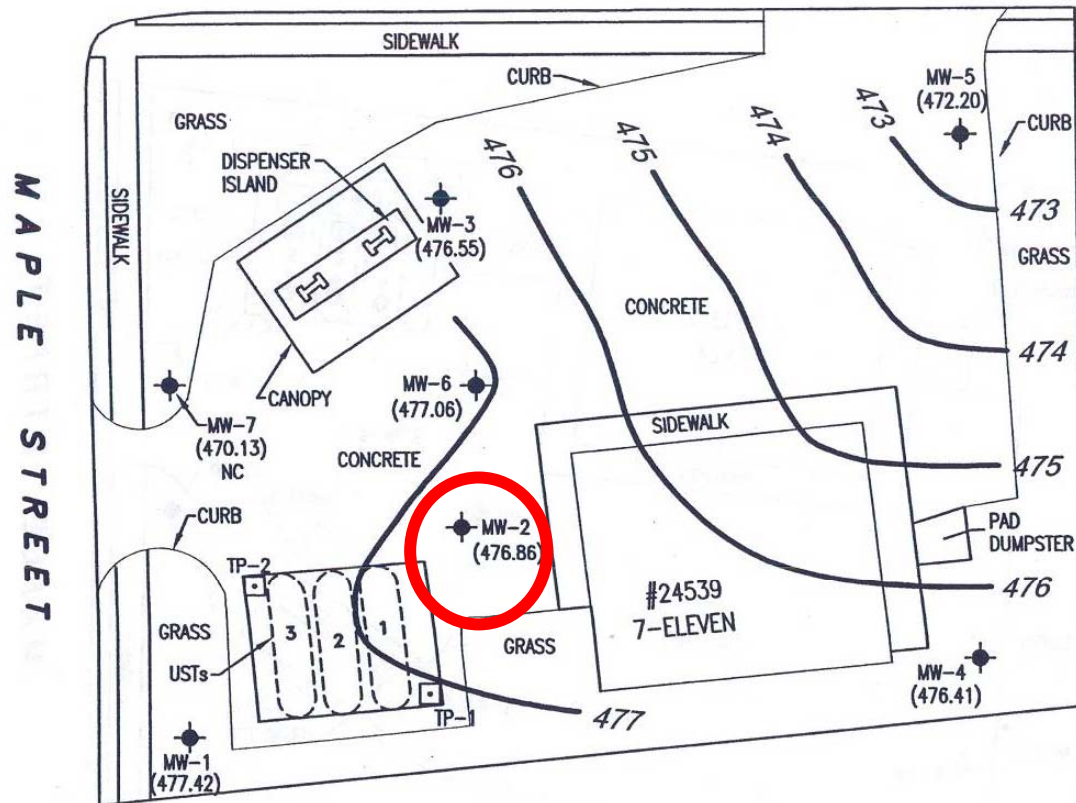


Tank Pit
Well #2

Tank Pit

10 feet



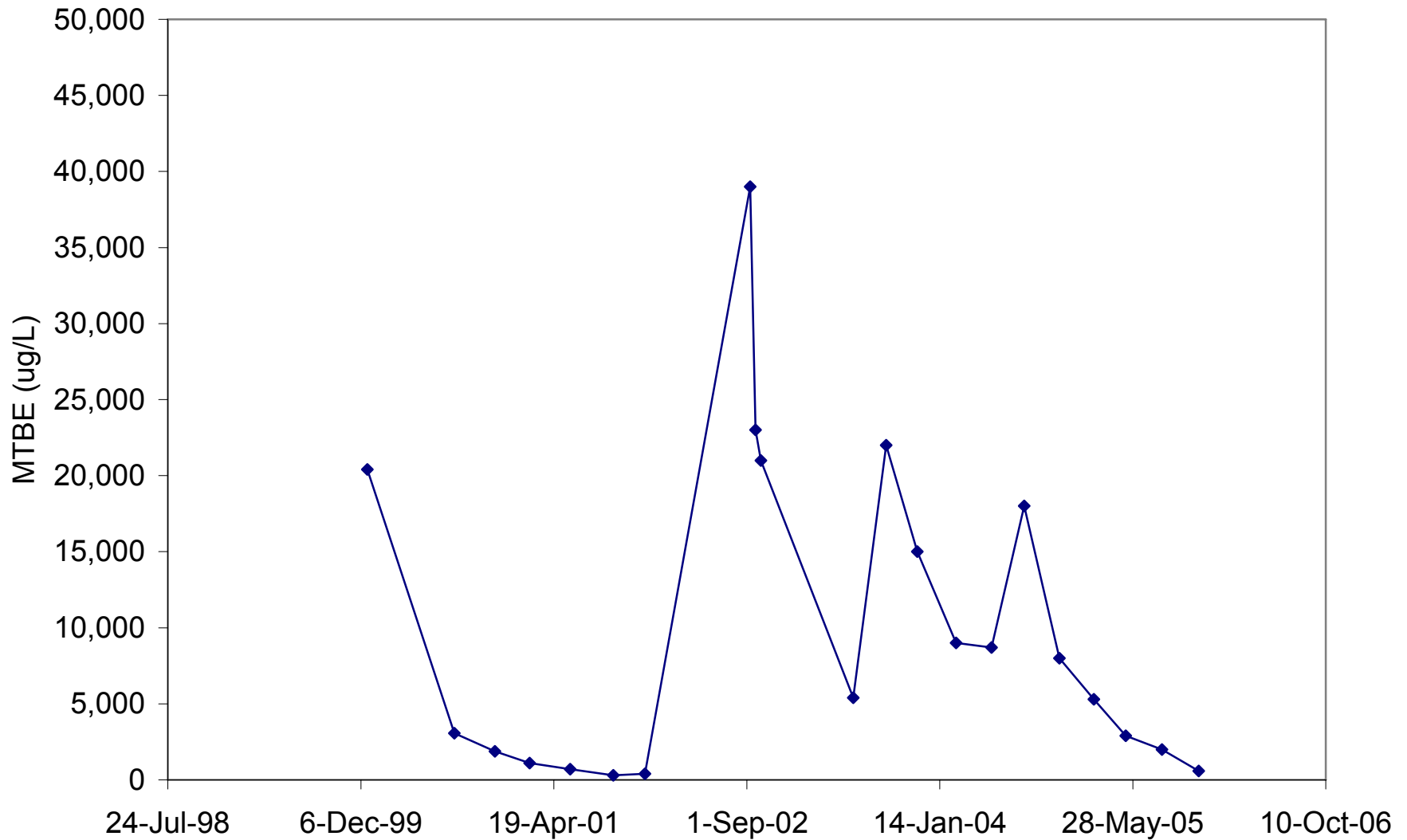


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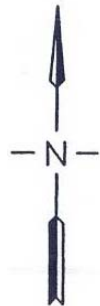
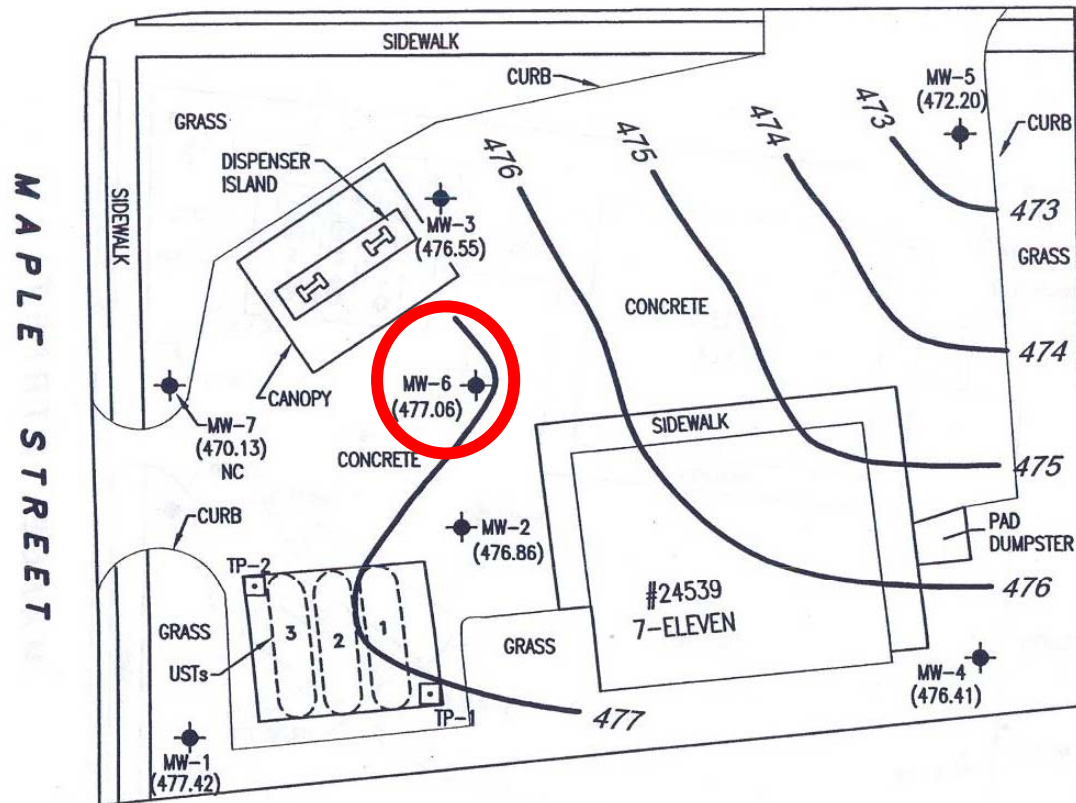


Concentration of MTBE MW-2



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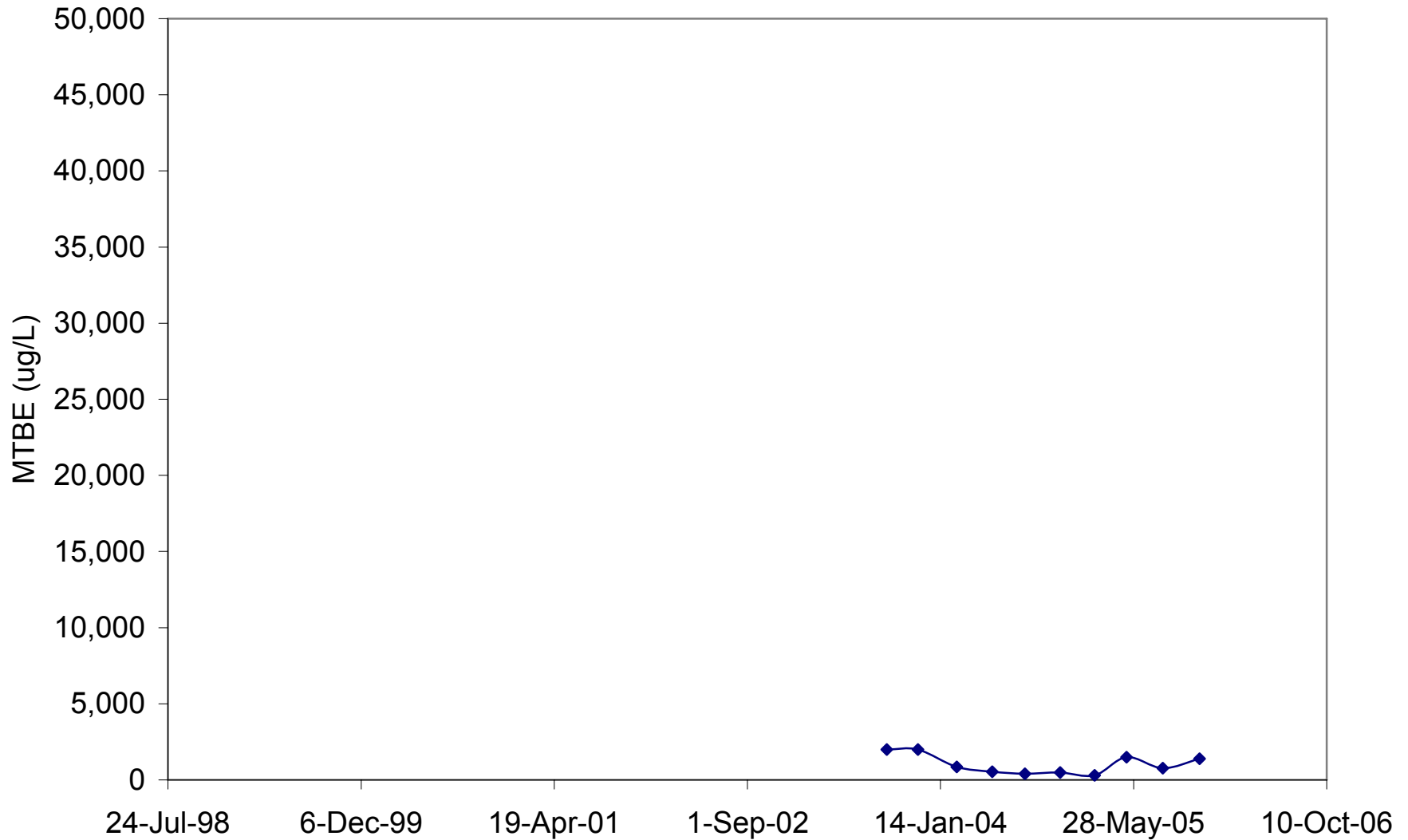


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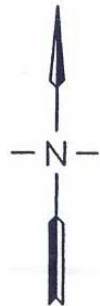
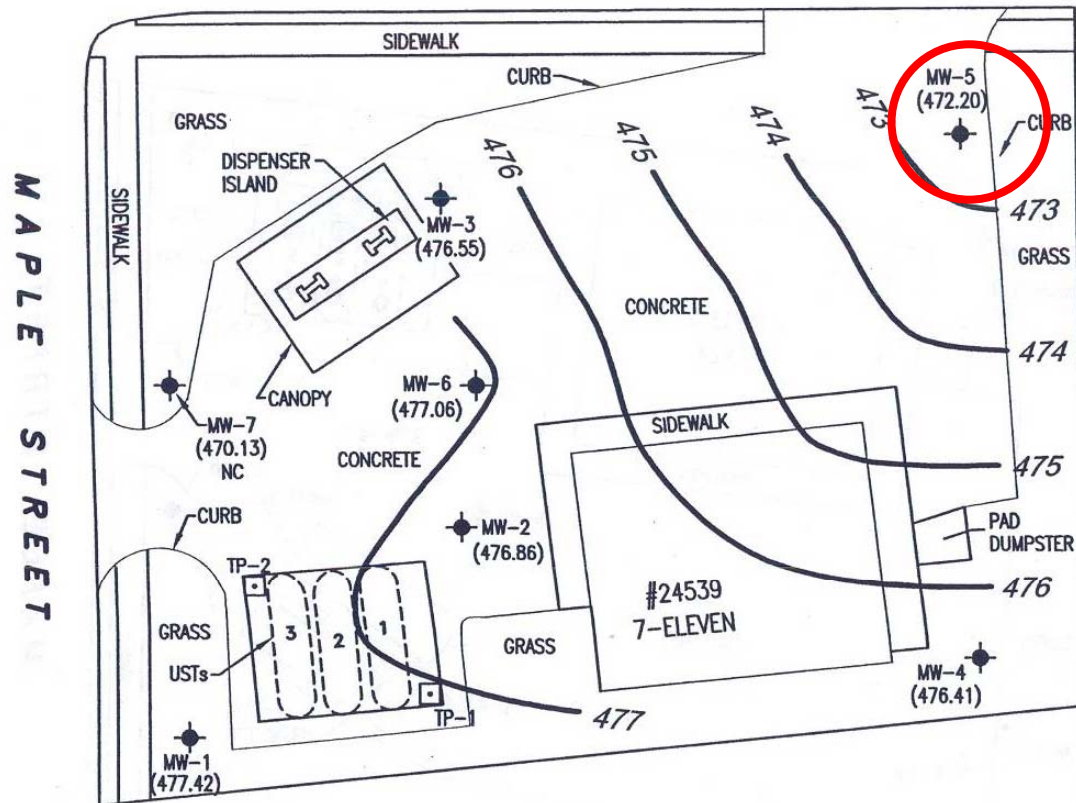


Concentration of MTBE MW-6



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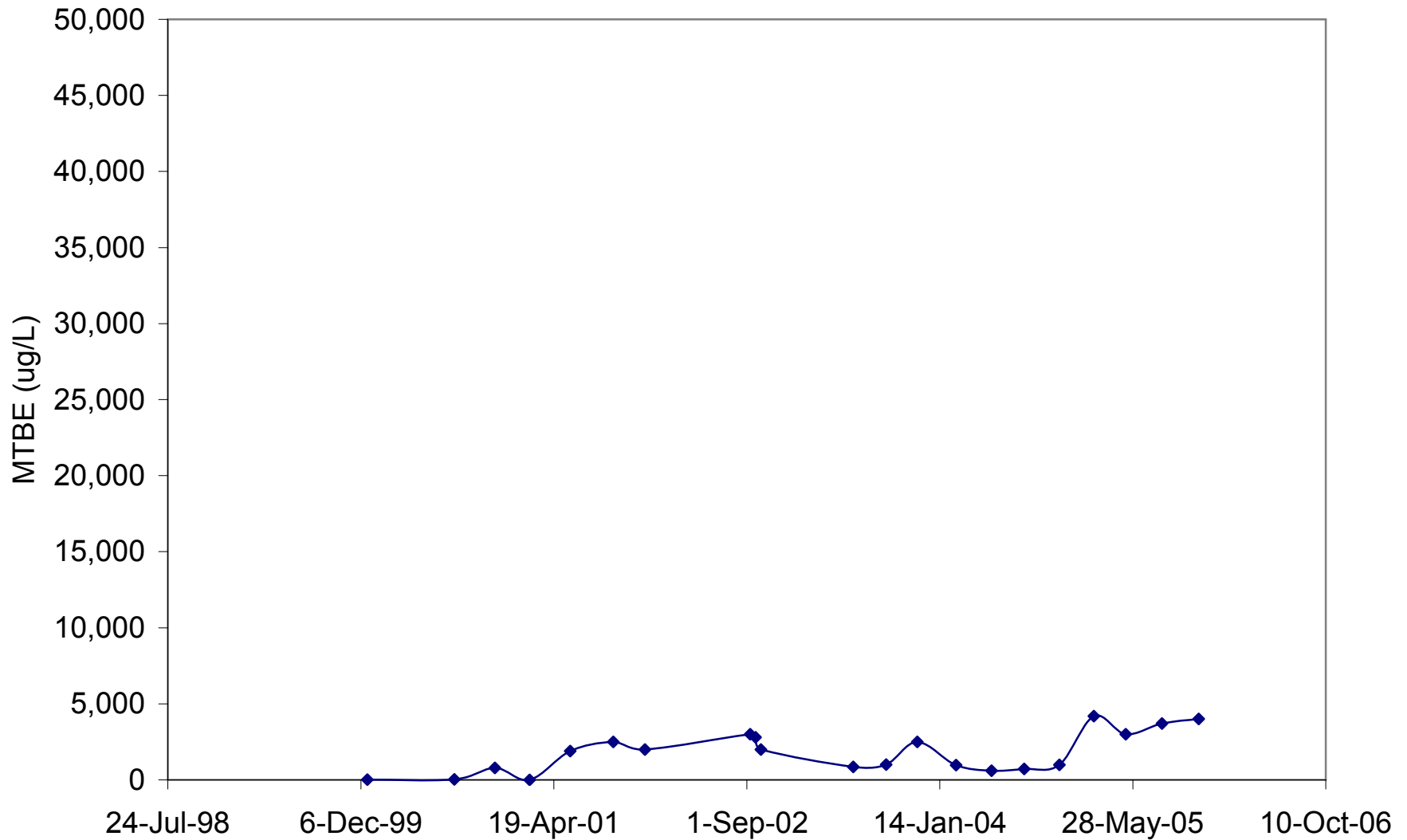


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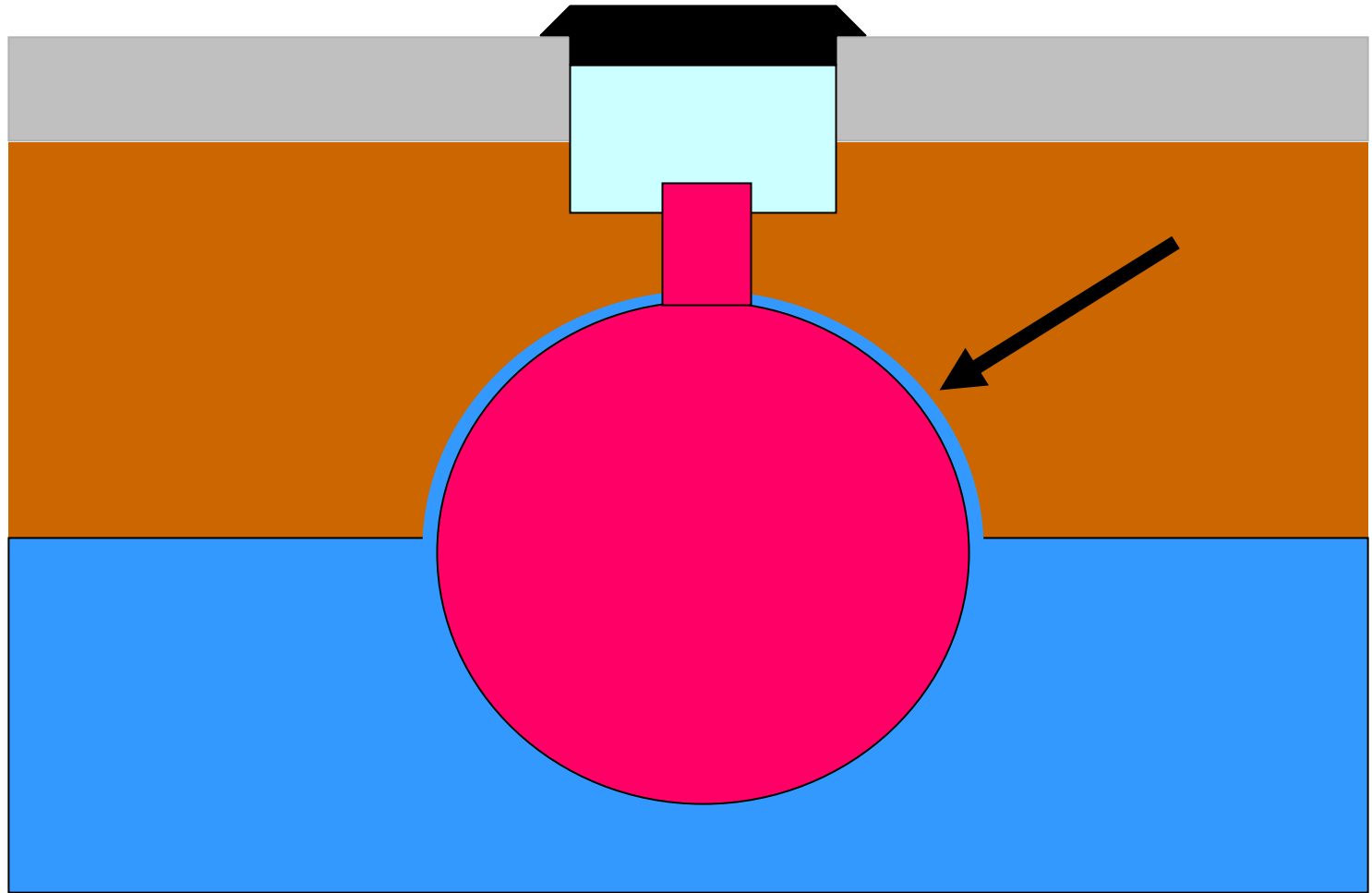
Concentration of MTBE MW-5



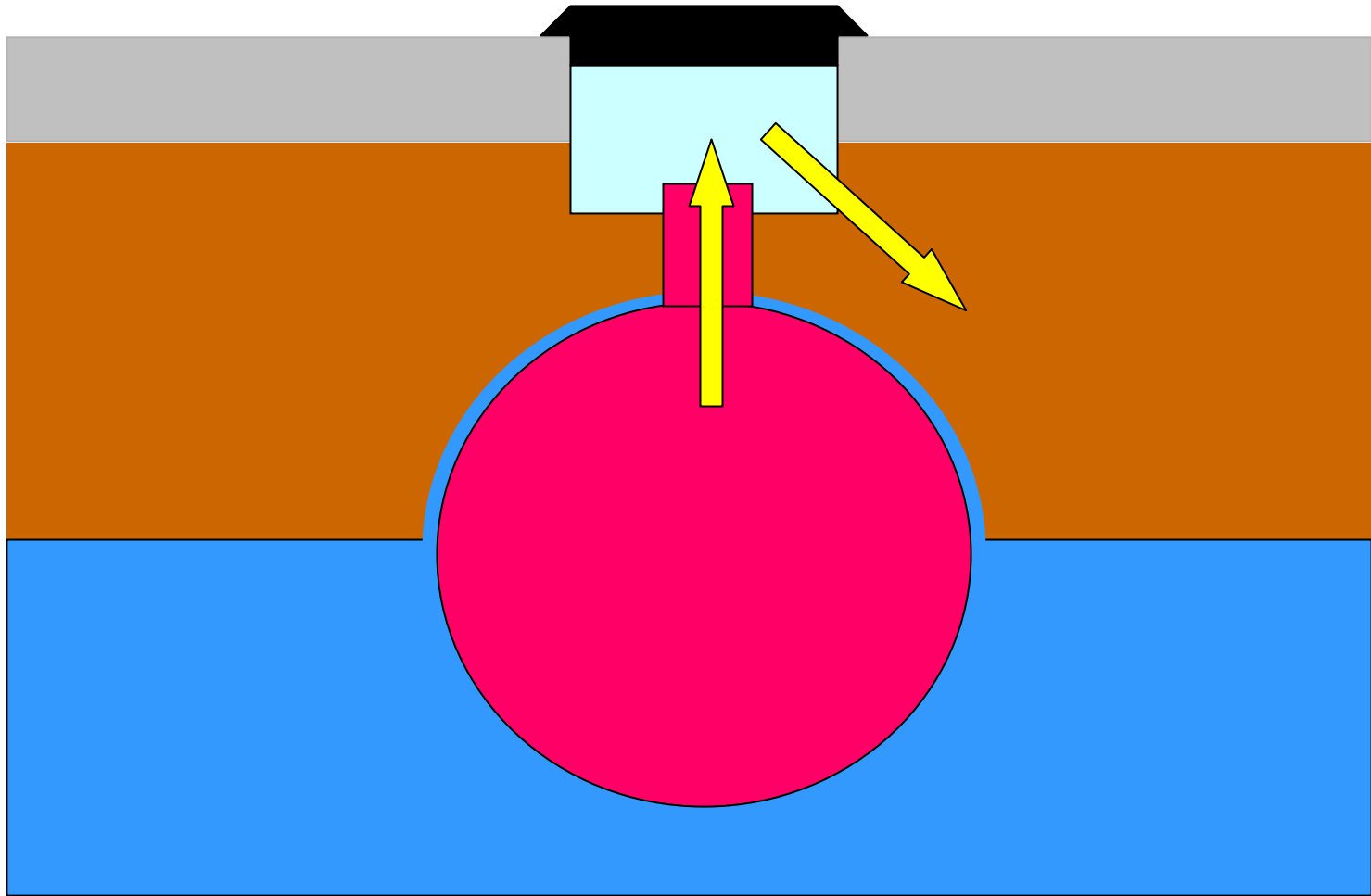
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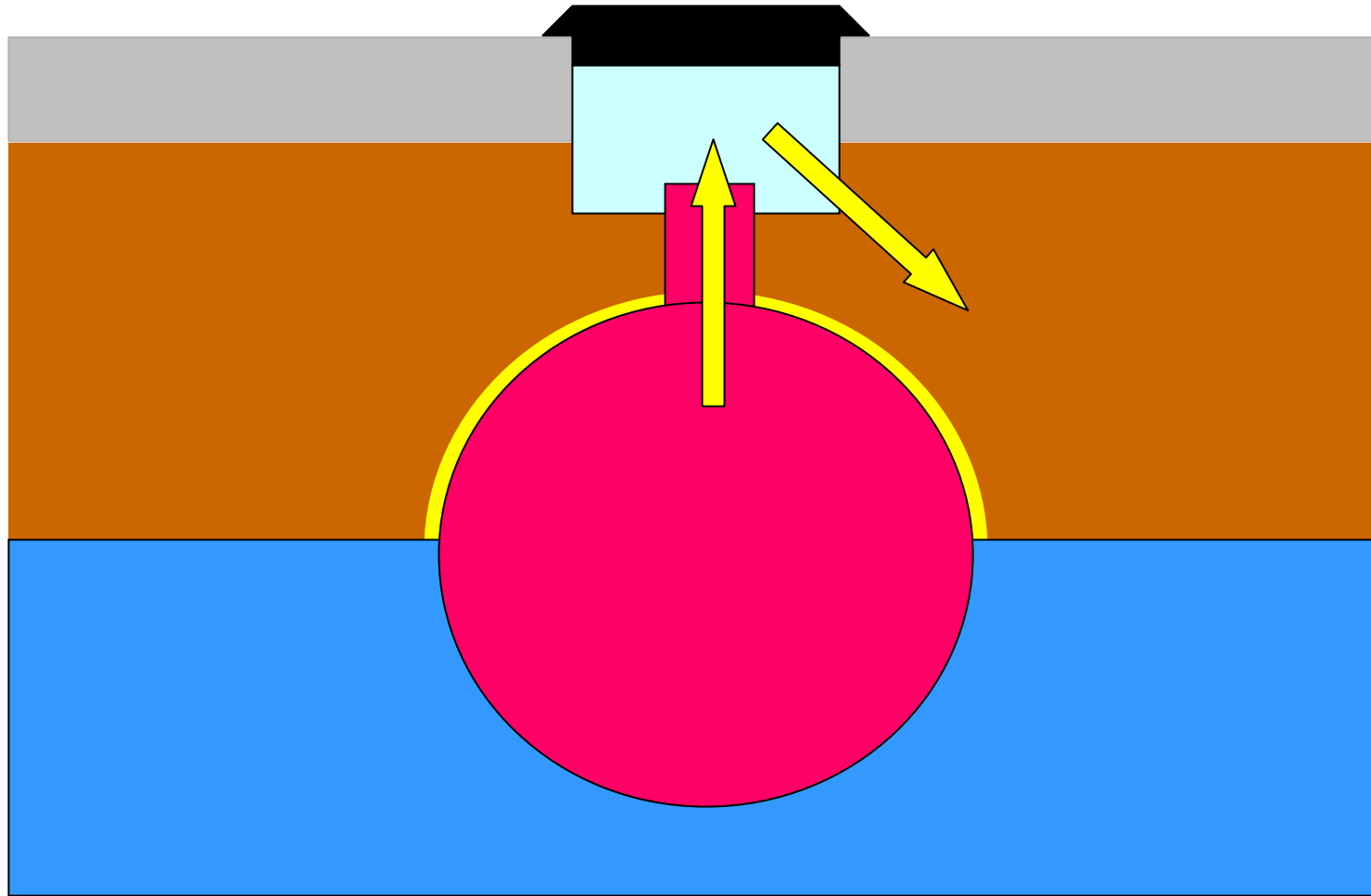
Water Vapor Condenses



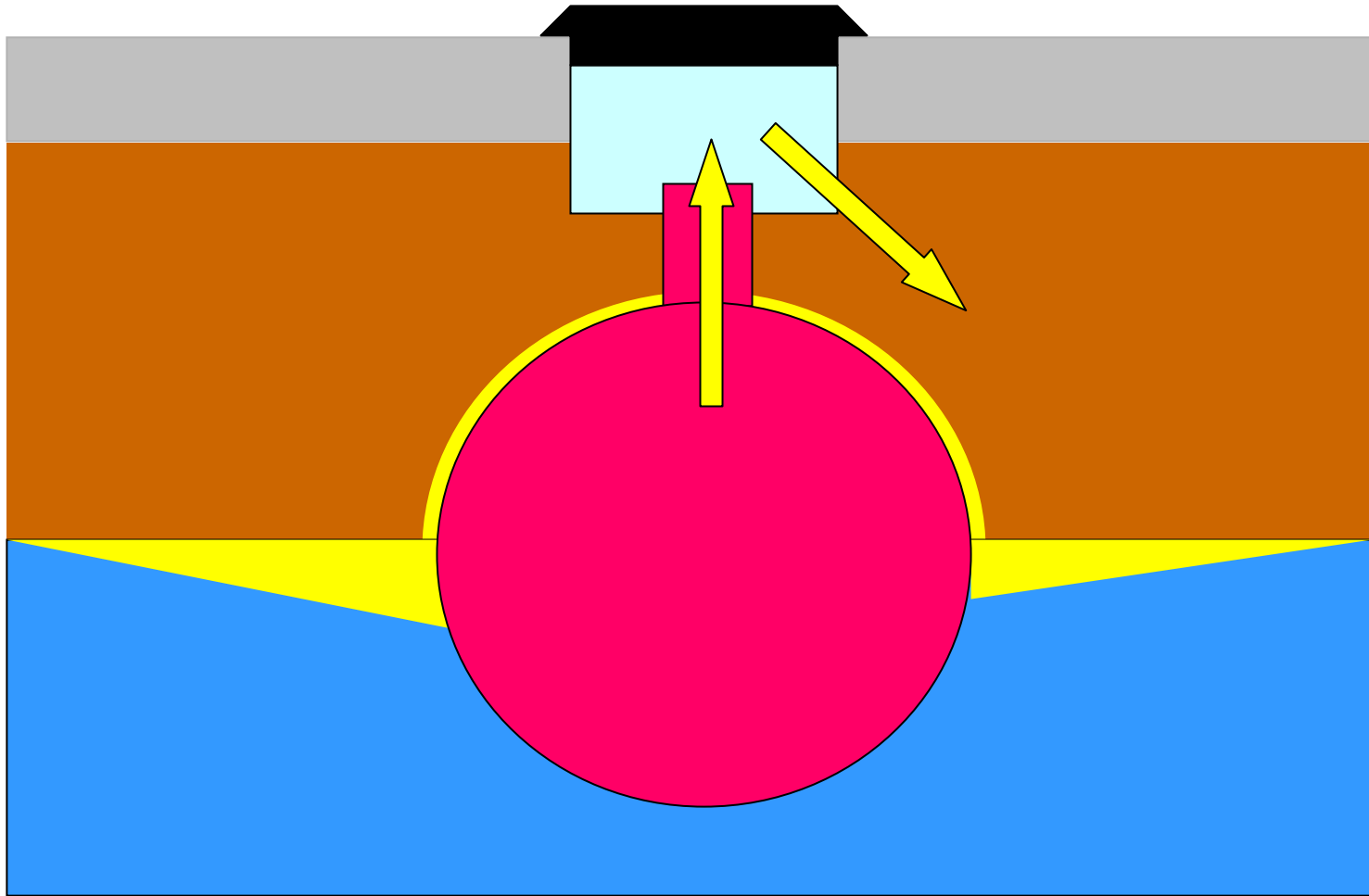
MTBE Vapors Escape UST



MTBE Vapors Dissolve in Condensate



MTBE in Ground Water in Tank Fill Material



Activities

- install a device in the vaults surrounding suspected sources of gasoline vapors that emits vapors of deuterium oxide D_2O (heavy water) at a slow rate over time
- install in the vaults devices that measures the concentration of MTBE vapors and D_2O vapors



Activities

- determine the concentration of MTBE vapors in the vault above the tank
- determine the concentration of D₂O in water vapors in the vault above the tank
- determine the concentrations of MTBE and D₂O in water in the ground water around the tank



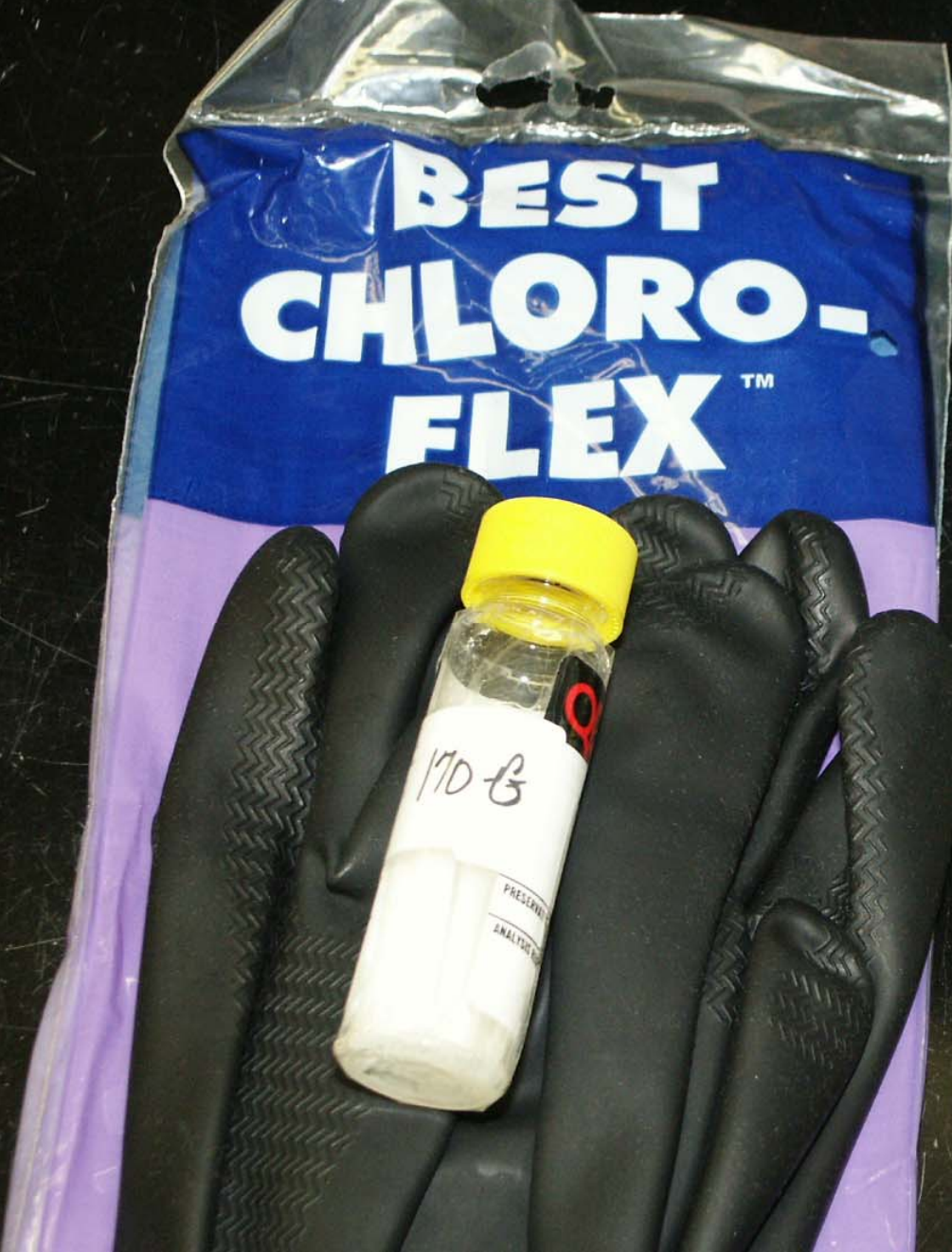
Activities

Based on the concentration of D_2O and MTBE vapors in the vaults, compared to the concentrations of D_2O and MTBE dissolved in ground water in the tank fill, determine whether particular potential sources are plausible causes of the MTBE in the ground water.



Passive Diffusion Samplers for MTBE Vapors





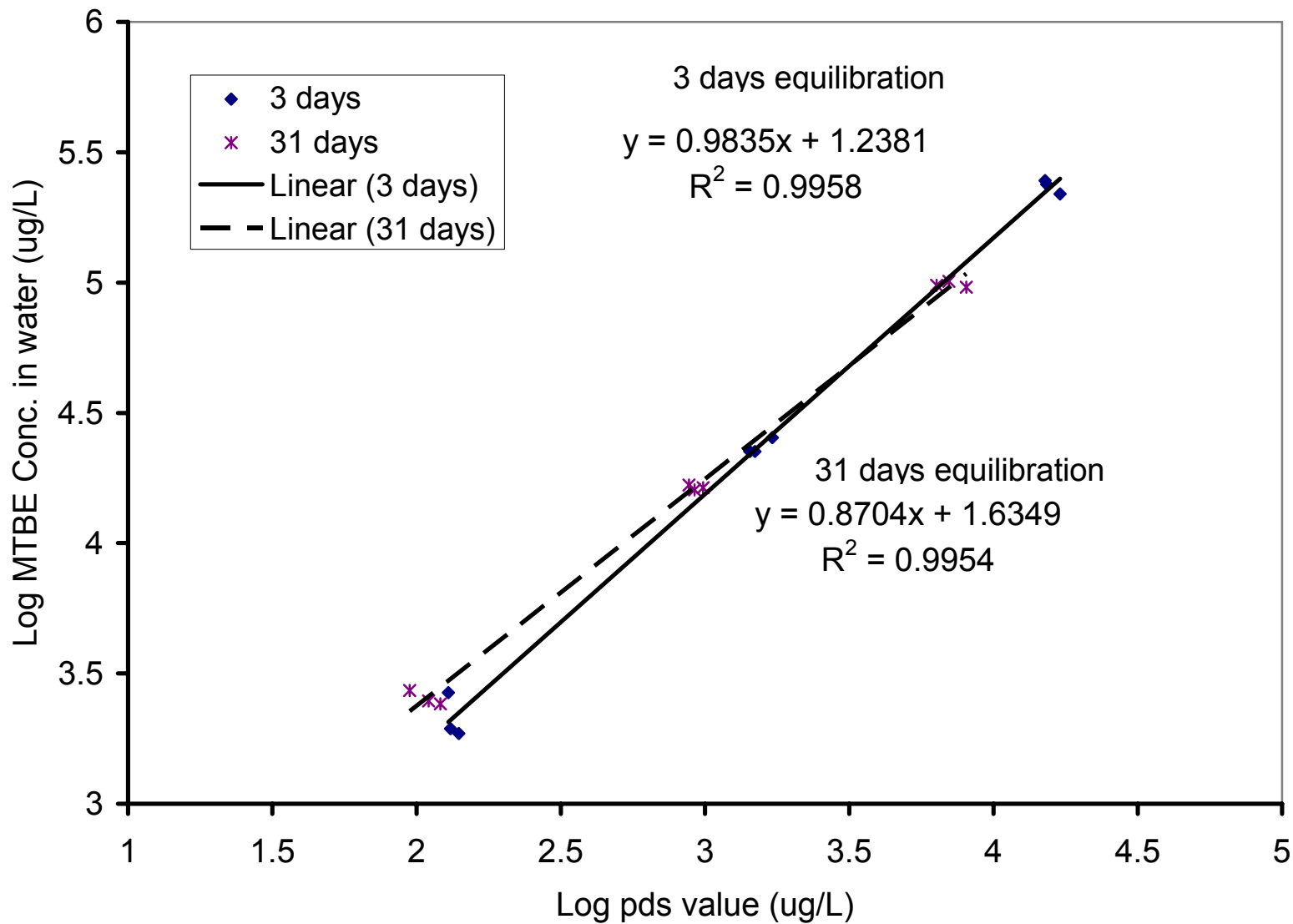
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Passive Diffusion Samplers for Water Vapor and D₂O Vapor





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Source of D₂O Vapor



Deuterium Oxide (D₂O)

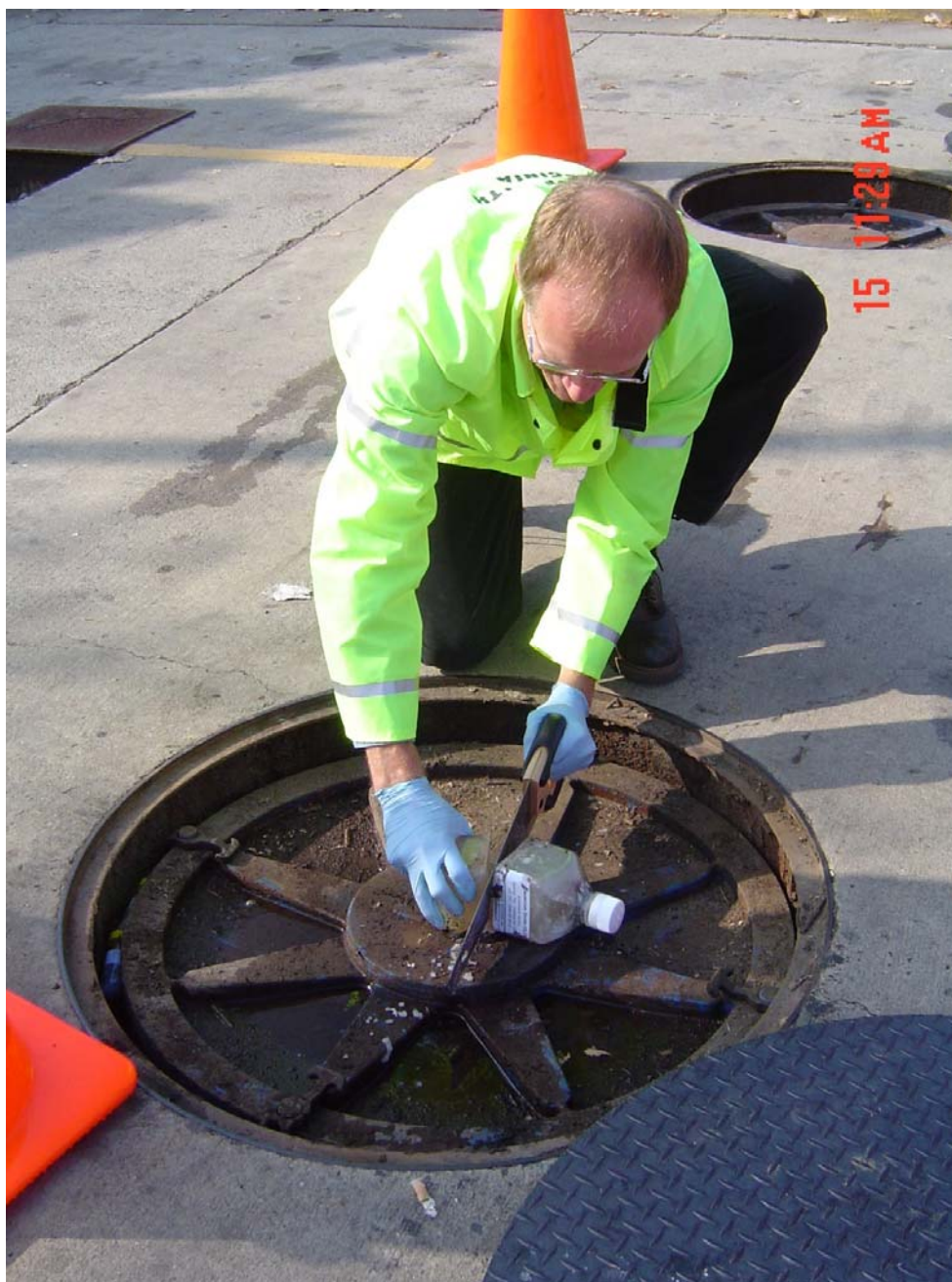
Enrichment: 99.5%

Quantity: 1Kg Catalog No: D5870

Lot: 150 Date: 09-26-05

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www.medicalisotopes.com



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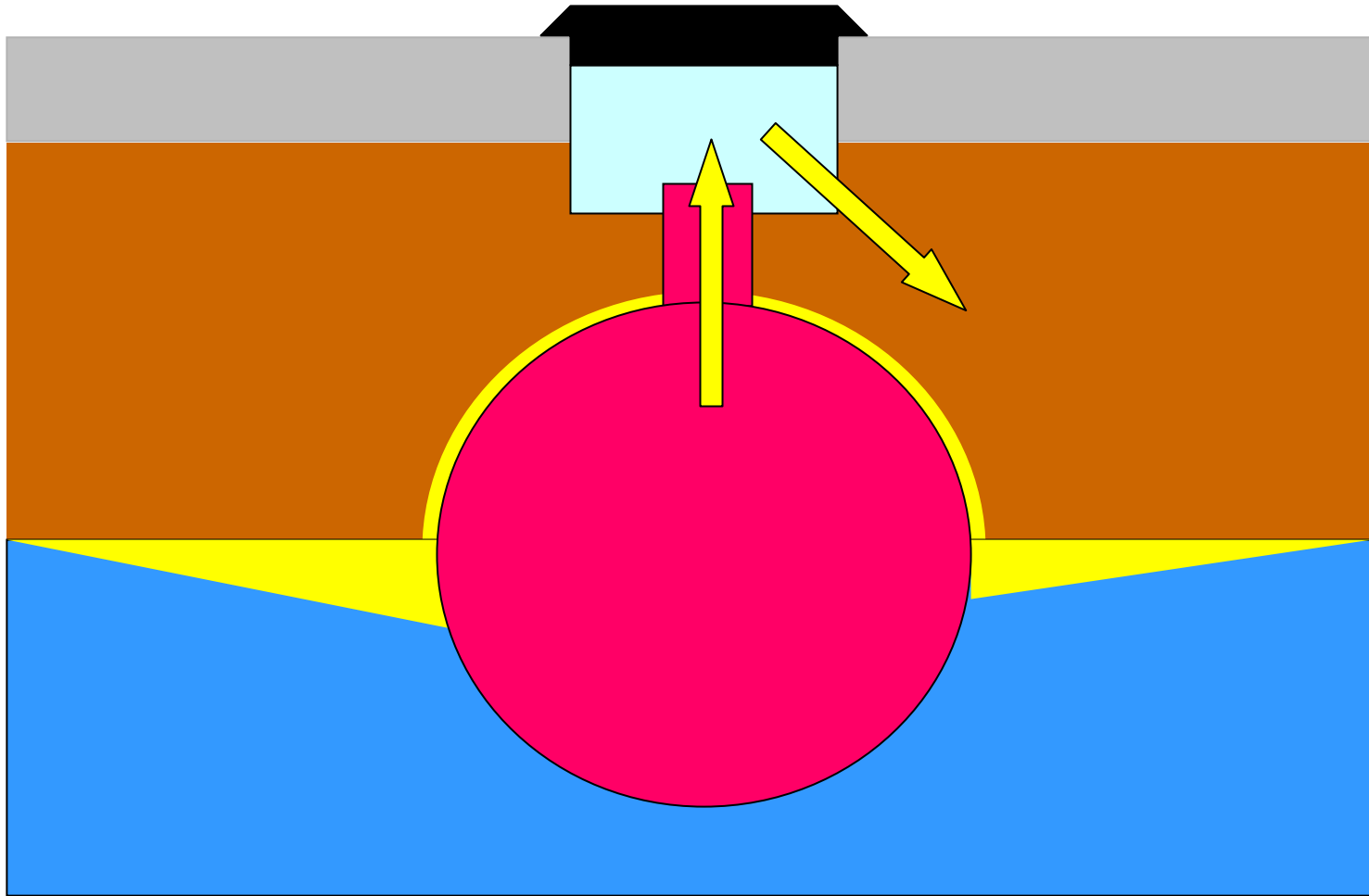


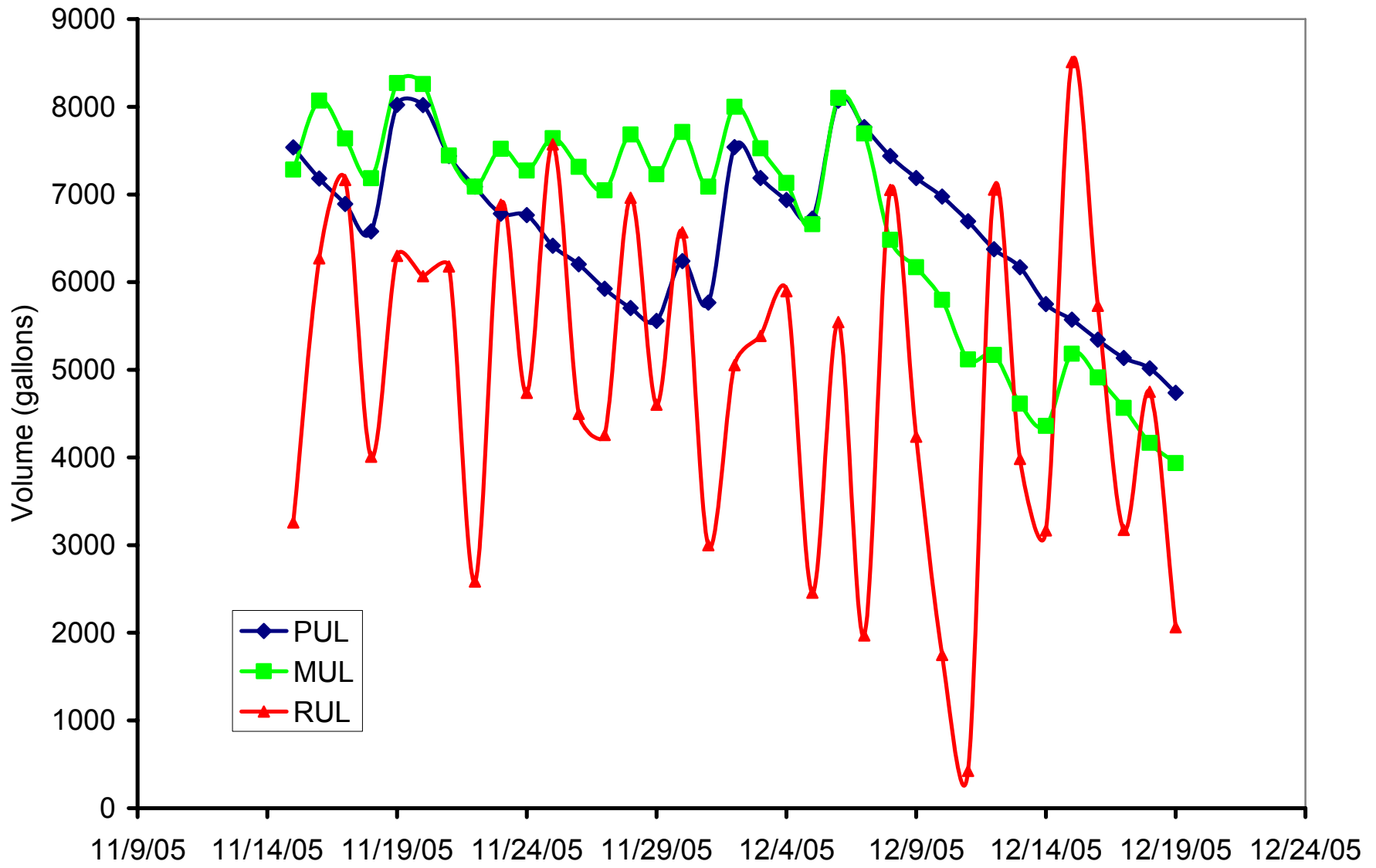


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MTBE in Ground Water in Tank Fill Material

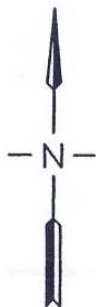
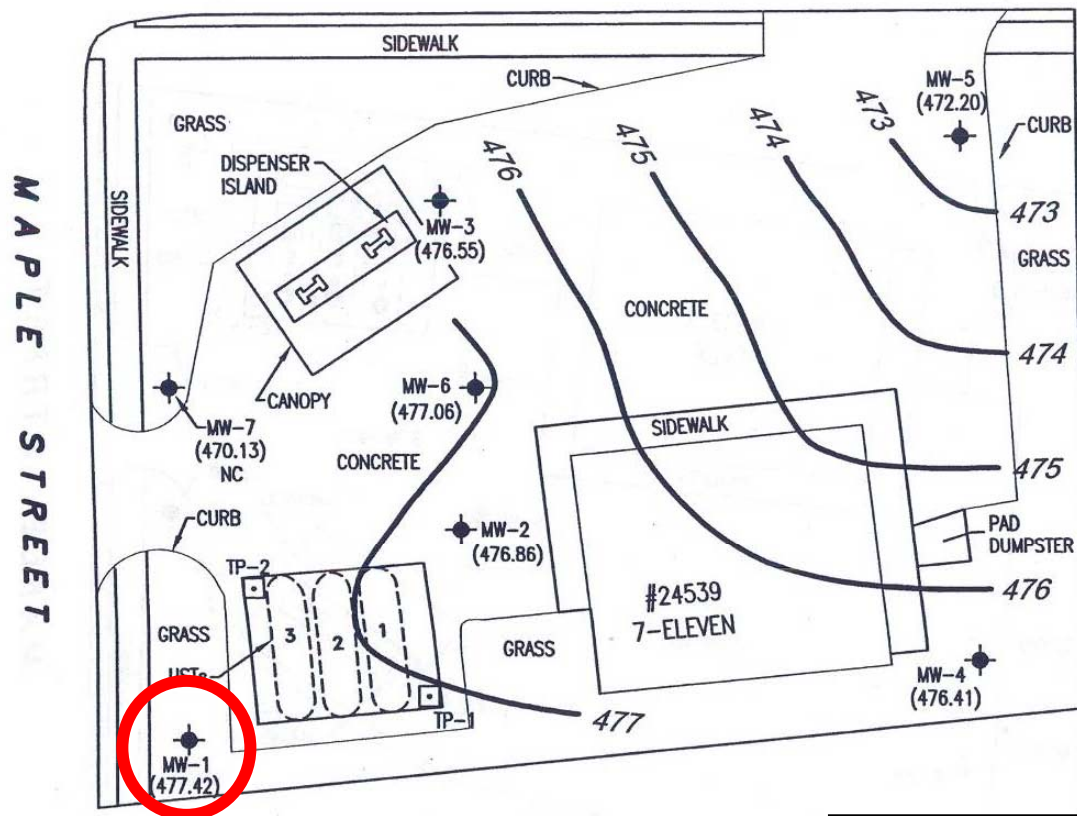




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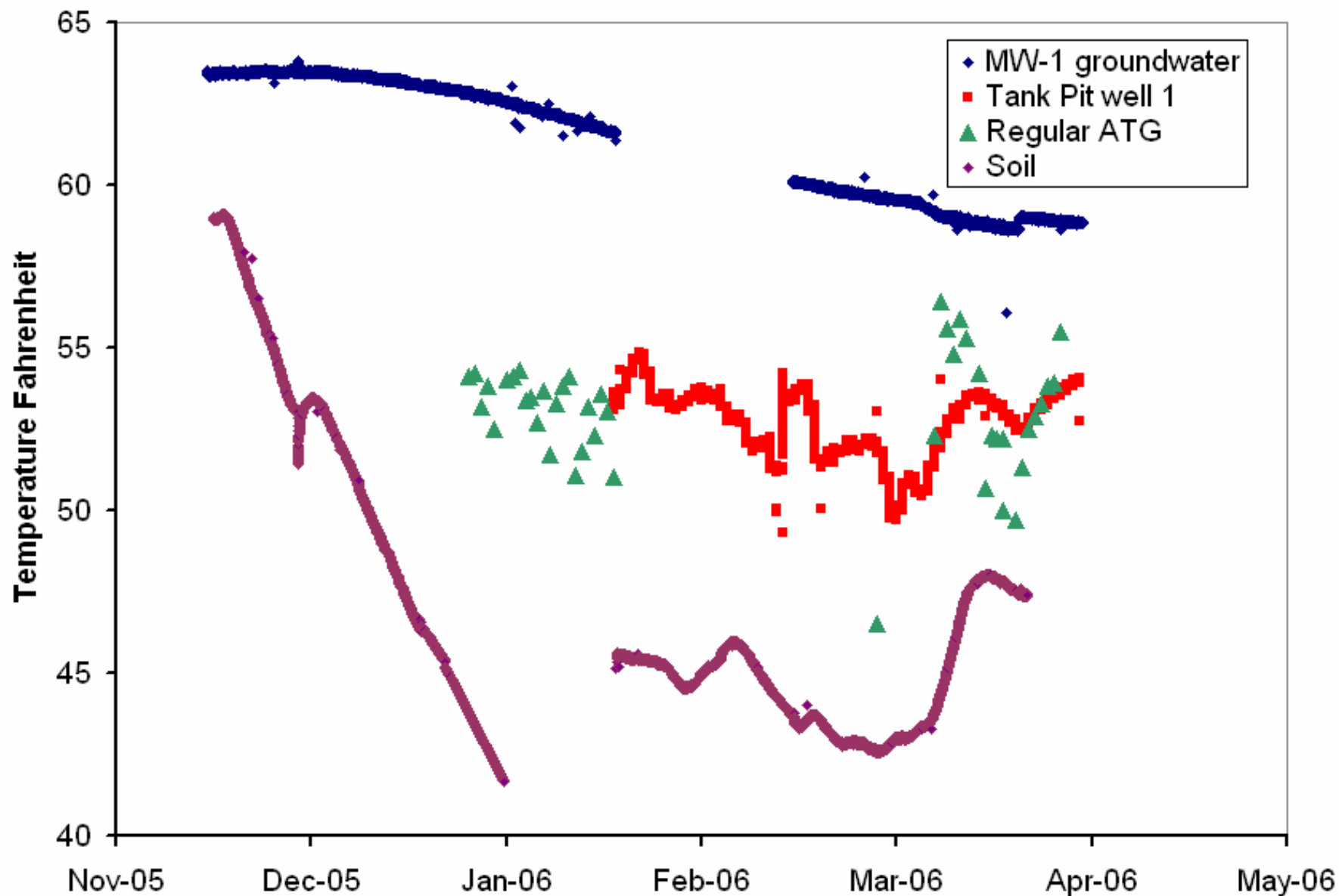
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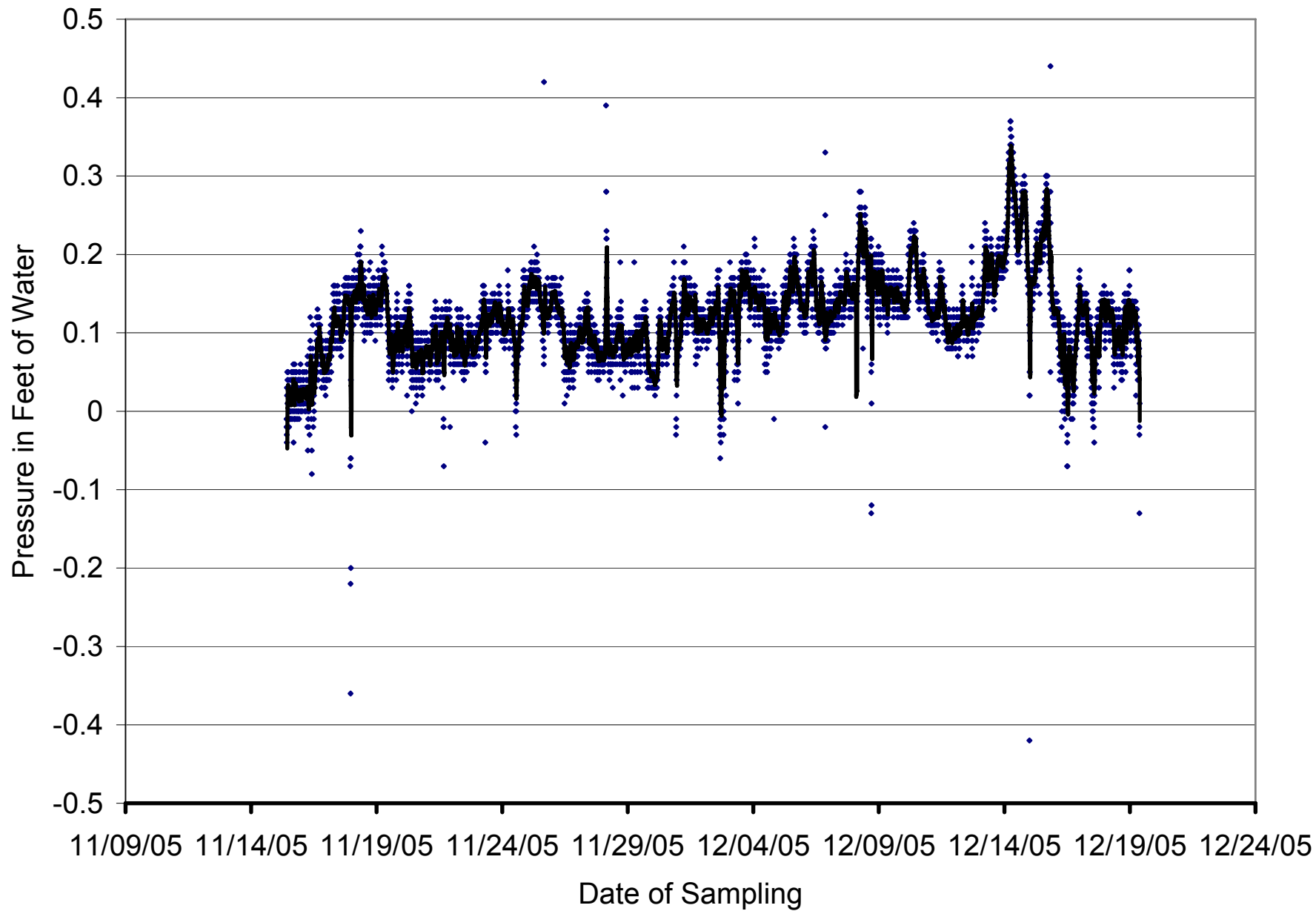
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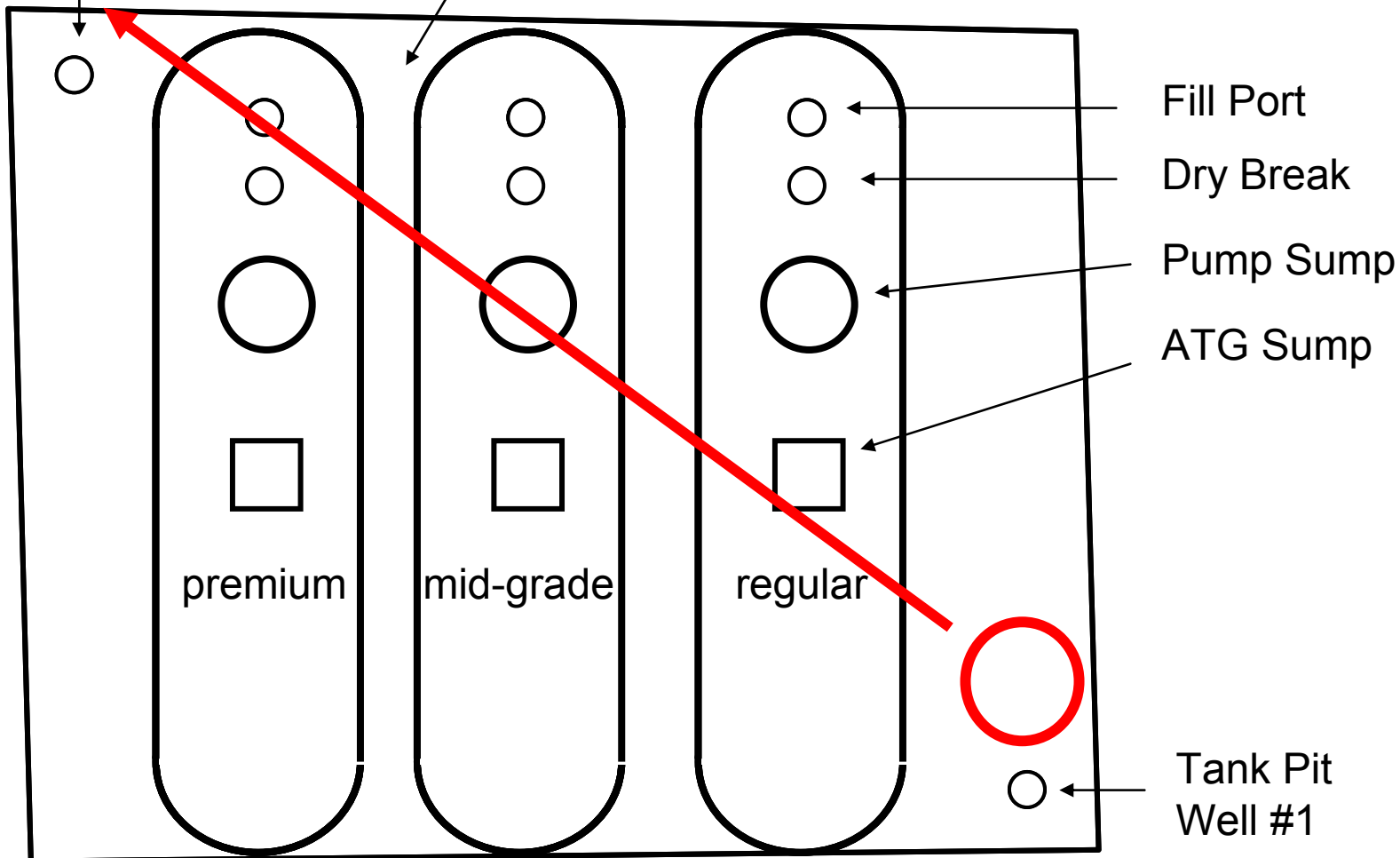
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Tank Pit
Well #2

Tank Pit

10 feet

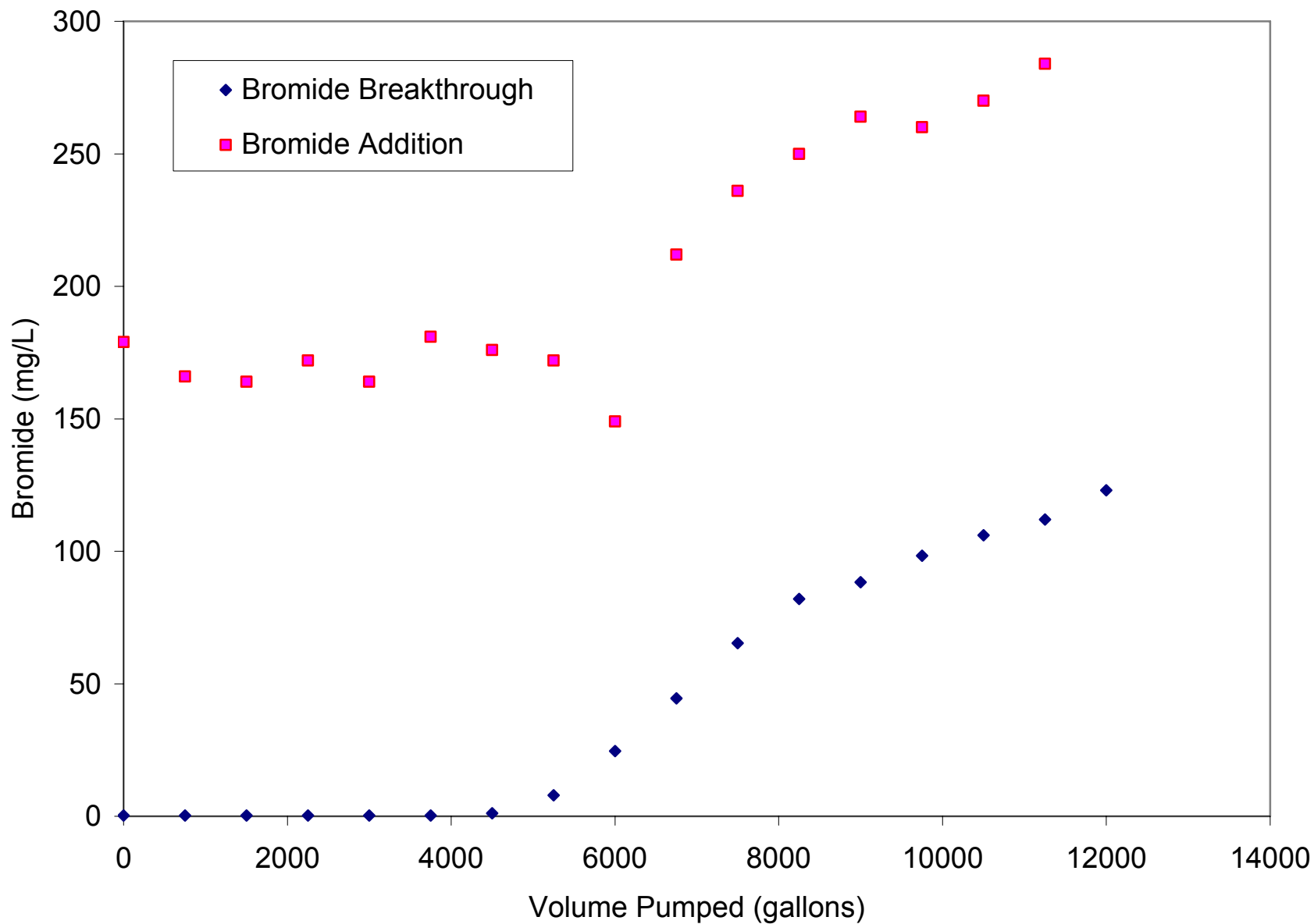


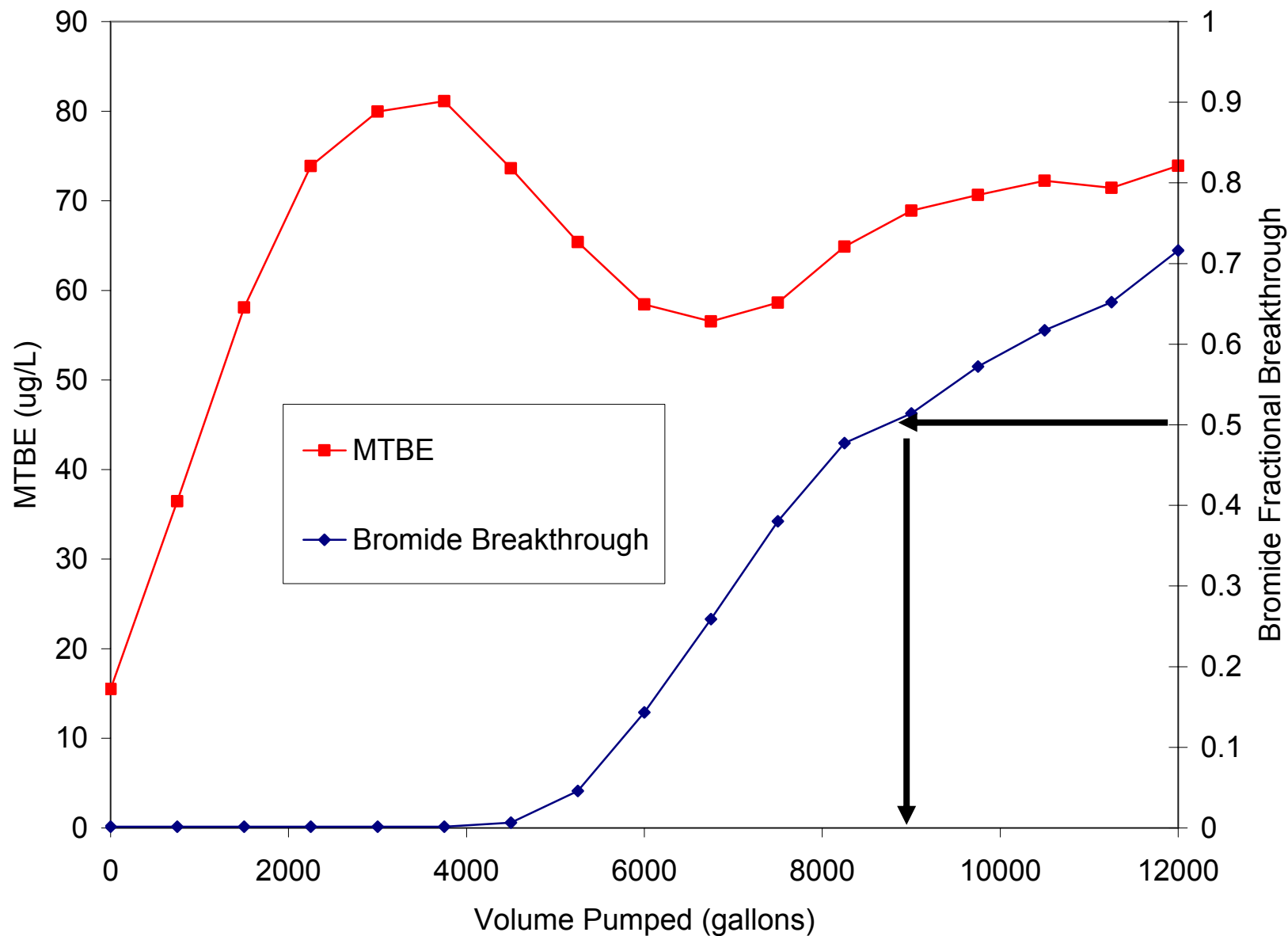


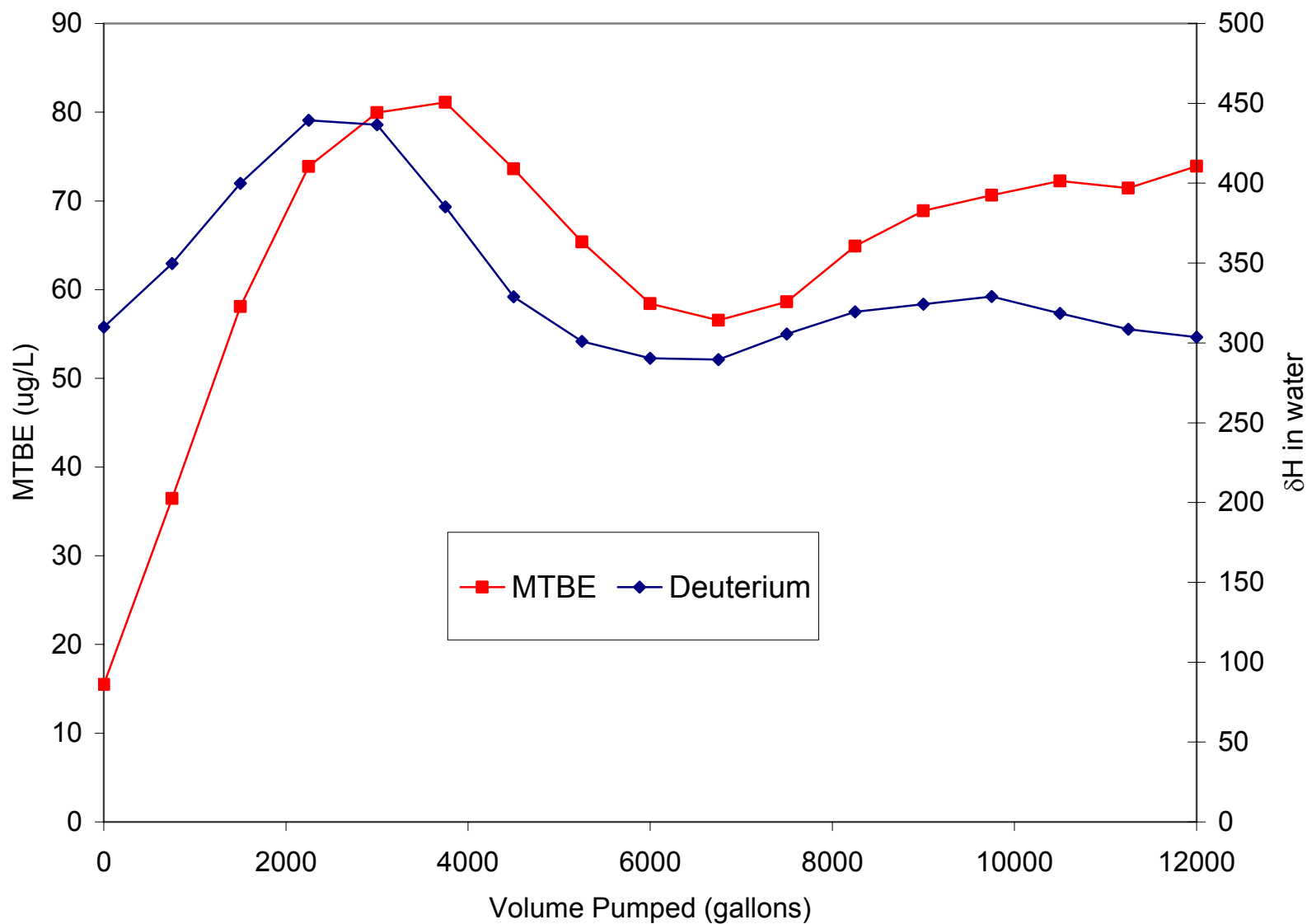












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We emplaced 15 liters of D₂O.

We recovered 2 liters in D₂O in the ground water in the tank fill.



Activities

Based on the concentration of D_2O and MTBE vapors in the vaults, compared to the concentrations of D_2O and MTBE dissolved in ground water in the tank fill, determine whether particular potential sources are plausible causes of the MTBE in the ground water.



mole ratio D/H in standard = 0.000156

$$\delta D_{\text{‰}} = \left(\frac{\text{Fraction D}_{\text{sample}} - \text{Fraction D}_{\text{standard}}}{\text{Fraction D}_{\text{standard}}} \right) * 1000$$

$$\Delta \delta D_{\text{sample}} = \delta D_{\text{sample}} - \delta D_{\text{background}}$$



$$\text{Additional } D_{\text{condensate}} = \text{Additional } D_{\text{tankfill}}$$

Where $K = 1000 * \text{mole ratio D/H in standard}$:

$$\text{Additional } D_{\text{tankfill}} = K * \Delta\delta D_{\text{tankfill}} * \text{Volume}_{\text{tankfill}}$$

$$\text{Additional } D_{\text{condensate}} = K * \Delta\delta D_{\text{condensate}} * \text{Volume}_{\text{condensate}}$$

$$\text{Volume}_{\text{condensate}} = \Delta\delta D_{\text{tankfill}} * \text{Volume}_{\text{tankfill}} / \Delta\delta D_{\text{condensate}}$$



$$\text{Total MTBE}_{\text{condensate}} = \text{Total MTBE}_{\text{tankfill}}$$

$$\text{Total MTBE}_{\text{tankfill}} = \text{Conc. MTBE}_{\text{tankfill}} * \text{Volume}_{\text{tankfill}}$$

$$\text{Total MTBE}_{\text{condensate}} = \text{Conc. MTBE}_{\text{condensate}} * \text{Volume}_{\text{condensate}}$$

$$\text{Expected Conc. MTBE}_{\text{condensate}} =$$

$$\text{Conc. MTBE}_{\text{tankfill}} * \text{Volume}_{\text{tankfill}} / \text{Volume}_{\text{condensate}}$$



The evaluation will be expressed as the ratio of the measured concentration of vapors in each vault to the concentration of vapors necessary to explain the MTBE in the ground water in the tank fill.



Date recovered	MTBE (ug/L water)	Deuterium in Water Vapor ($\delta D\text{‰}$)	Deuterium in Water Vapor %(H+D)
Regular Dry Break			
12/16/2005	9590	38,037	0.60
1/19/2006	4941	2,522,112	28.20
2/16/2006	3827	68,320	1.07



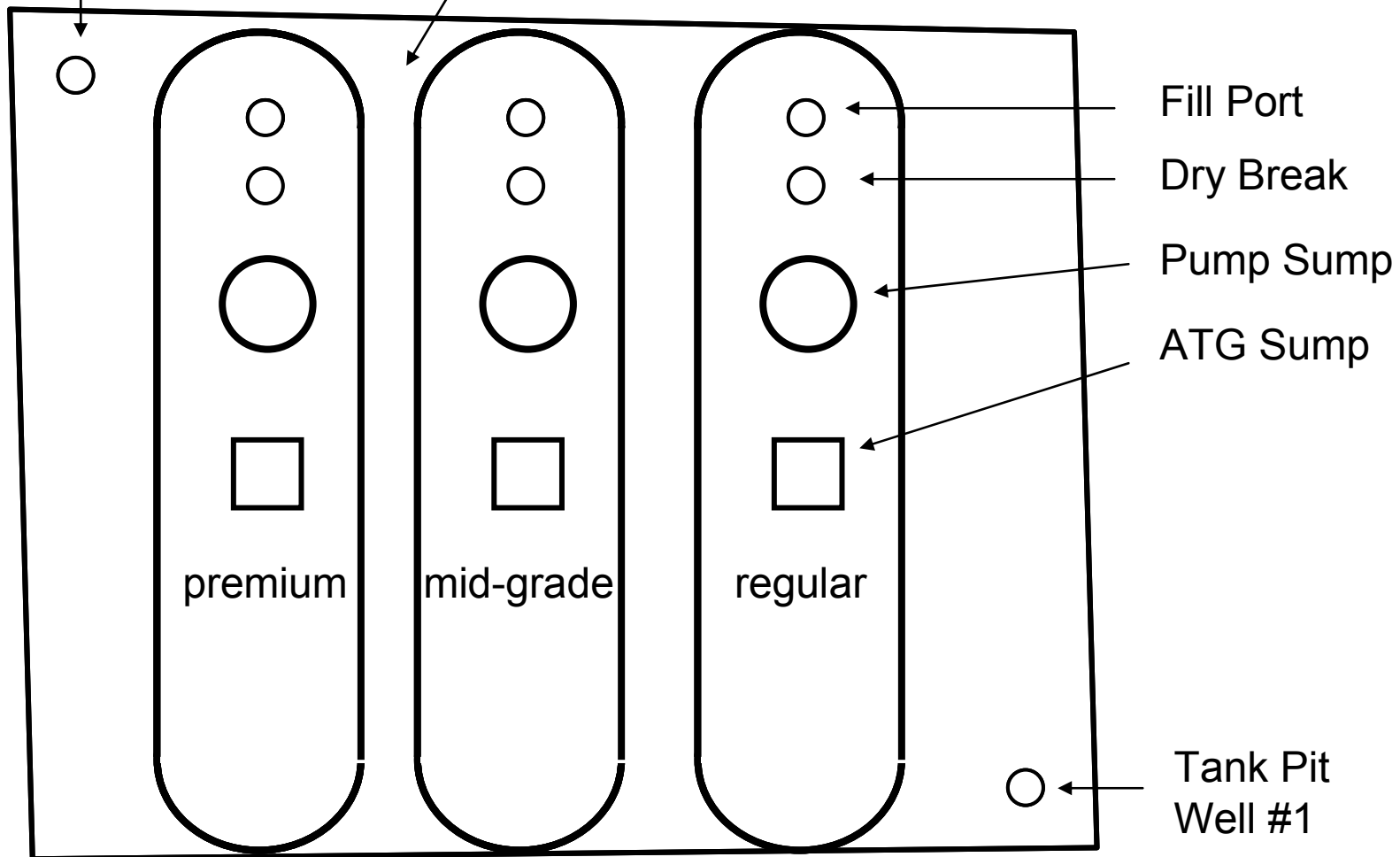
Date recovered	MTBE measured (ug/L water)	MTBE required (ug/L water)	Ratio measured to required
Regular Dry Break			
12/16/2005	9,590	6,188	1.55
1/19/2006	4,941	410,322	0.01
2/16/2006	3,827	11,115	0.34



Tank Pit
Well #2

Tank Pit

10 feet



Location	Date recovered	Ratio measured to required
Mid-Grade ATG	12/16/2005	0.09
Mid-Grade ATG	1/19/2006	0.02
Mid-Grade ATG	2/16/2006	0.04



Location	Date recovered	Ratio measured to required
Mid-Grade Dry Break	12/16/2005	0.33
Mid-Grade Dry Break	12/16/2005	0.91
Mid-Grade Dry Break	1/19/2006	0.00
Mid-grade Dry Break	2/16/2006	0.13



Location	Date recovered	Ratio measured to required
Mid-Grade Sump	12/16/2005	0.14
Mid-Grade Sump	12/16/2005	0.05
Mid-Grade Sump	1/19/2006	0.03
Mid-Grade Sump	1/19/2006	0.02
Mid-grade Sump	2/16/2006	0.03
Mid-grade Sump	2/16/2006	0.02



Location	Date recovered	Ratio measured to required
Premium ATG	12/16/2005	0.93
Premium ATG	1/19/2006	0.02
Premium ATG	2/16/2006	0.01



Location	Date recovered	Ratio measured to required
Premium Dry Break	12/16/2005	0.26
Premium Dry Break	1/19/2006	0.01
Premium Dry Break	2/16/2006	0.01



Location	Date recovered	Ratio measured to required
Premium Sump	12/16/2005	0.03
Premium Sump	12/16/2005	0.00
Premium Sump	1/19/2006	0.01
Premium Sump	1/19/2006	0.02
Premium Sump	2/16/2006	0.01
Premium Sump	2/16/2006	0.01



Location	Date recovered	Ratio measured to required
Regular ATG	12/16/2005	0.02
Regular ATG	1/19/2006	0.03
Regular ATG	2/16/2006	0.02



Location	Date recovered	Ratio measured to required
Regular Dry Break	12/16/2005	1.55
Regular Dry Break	1/19/2006	0.01
Regular Dry Break	2/16/2006	0.34



Location	Date recovered	Ratio measured to required
Regular Sump	12/16/2005	0.00
Regular Sump	12/16/2005	0.01
Regular Sump	1/19/2006	0.01
Regular Sump	1/19/2006	0.01
Regular Sump	2/16/2006	0.15
Regular Sump	2/16/2006	0.03





